# SEASONAL AND DAILY EMERGENCE PATTERNS OF ADULT THYRIDOPTERYX EPHEMERAEFORMIS (LEPIDOPTERA: PSYCHIDAE)[1]

R. D. Morden and G. P. Waldbauer[2]

The evergreen bagworm, *Thyridopteryx ephemeraeformis* (Haworth), has only one generation per year. Compared with many other insects the adults emerge and mate late in the season, beginning about the middle of September in central Illinois. There is little information concerning the seasonal pattern of emergence of this species, and there are conflicting reports of the daily pattern of emergence. Therefore, we have attempted to resolve these differences in information by collecting data both in the field and in the laboratory.

Riley (1869) reported that males of *T. ephemeraeformis* emerge during the warm morning hours and are most active at this time of day, but Kaufmann (1968) observed that males appeared toward evening and were very active during the night, becoming quiet before sunrise. Jones and Parks (1928) did not present data, but stated that males may fly at any hour, but most frequently after mid-day and before dark. Jones (1927) found that all flights cease before dusk except on warm still evenings.

Riley (1869) related that "Dr. Harris wrote to Edward Doubleday, on the 29th of October, 1849 as follows: 'The males are disclosed in September and the early part of October, and immediately afterwards the females will be found to be impregnated. I examined about fifty female follicles on the 25th of October, and found all the females es-

[1]Accepted for publication: May 20, 1971 [3.0112].

[2]Department of Entomology, University of Illinois, Urbana, IL 61801.

caped, and their puparia half full of fertilized eggs.'" This was in the Philadelphia area. Dates of emergence in Delaware ranged from August 31 to October 26 with emergences later than October 10 being few (Jones, 1927). In Ohio adult males emerge from their bags and begin their mating flight in search of the wingless females in September and October (Wollerman, 1965).

Methods and Materials.—To determine emergence times of adults bags were collected from a *Juniperus virginiana* shrub in the field in Champaign County, Illinois on September 5, 1969. The bags were cut open longitudinally and the males and females were separated. The rigidity of the bag allowed it to reclose firmly along the original cut. Males were easily identified by their smaller size, greater amount of silk lining in their bags, and the presence of legs and other appendages on the pupa. In contrast females do not have wings, antennae or normally segmented legs. Whether or not an adult male had emerged was determined by whether or not the pupal exuviae protruded from the bag. Before the emergence of the adult male the pupa wriggles part way out of the bag and hangs head down with its posterior end still attached to the bag. Since females do not emerge from the bag it is difficult to determine when they become adults. Therefore, only male bagworms were used in these experiments.

One hundred eighty five bags containing males were strung on a string, draped on a masonite board and placed on a fence. Therefore, they received approximately the same amount of sunlight as if left on the shrub. The bags were examined every three hours daily to see how many adults had emerged or flown. The temperature was recorded at each observation.

Ninety-eight of the bags containing males were brought into laboratory conditions of 29°C and a 12.5 hour photophase (8:00 a.m. to 8:30 p.m.), approximating the photoperiod they would have received in the field. These also were checked every three hours. A similar procedure had been followed in the spring of 1969 when we used 40 male bagworms which had been reared from egg to adult in the laboratory under a 16 hour photophase. The latter pupae were maintained in the laboratory at a 16 hour photophase (8:00 a.m. to midnight) and 25°C. All photoperiods are based on a 24 hour cycle.

Results and discussion.—In 1969 males emerged between September 14 and October 6 (Figure 1). It is also apparent that the

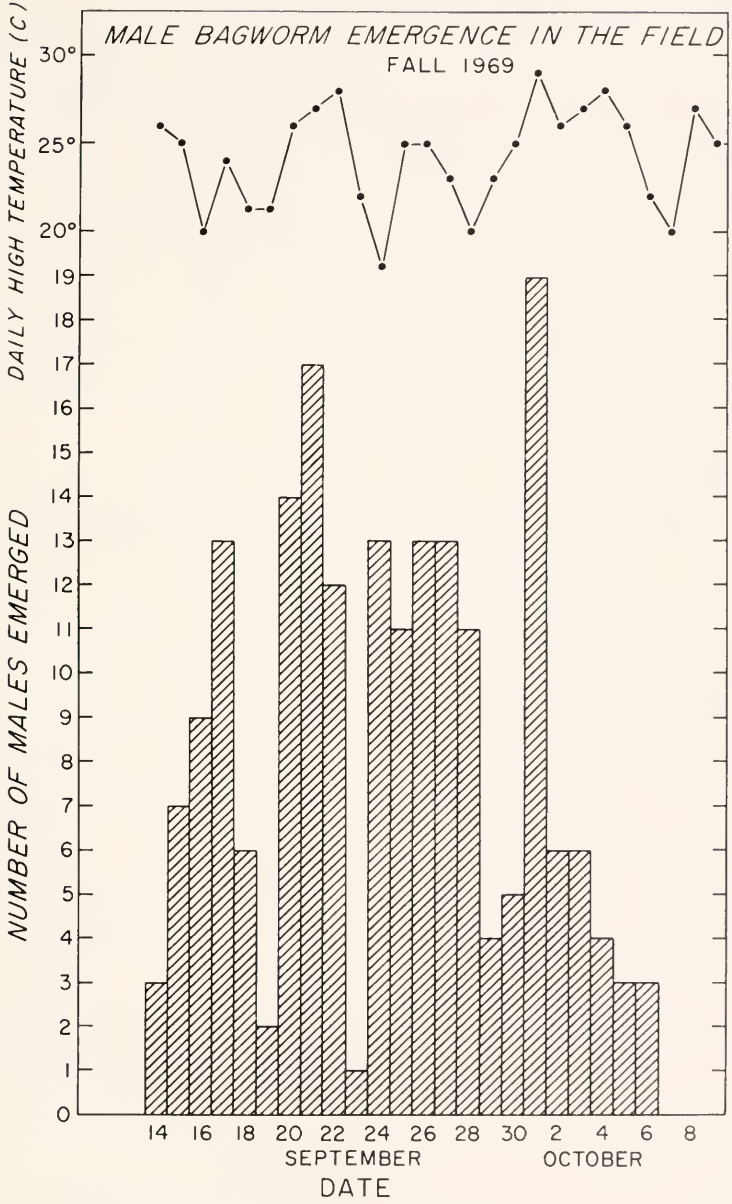


**Figure 1.** Histogram of the distribution and frequency of male bagworm emergence in relation to daily high temperature in the field during 1969.

frequency of emergence during this period was positively correlated with the temperature.

During the fall of 1970 we observed natural populations of bagworms in the field. The first emergence of males was noted on September 15. It was a warm day with a high of 32.2°C. At 7:00 p.m., when the temperature was 26°, twenty-five to fifty male moths swarmed around a juniper tree that contained female bags. Males continued to fly until the last traces of light were evident and then they disappeared. We were unable to detect any in the tree by shaking it and could not find any within twenty feet of the tree either on objects or on the ground. A double mantle gas lantern was five feet from the juniper tree when many males were flying just before dark. No males were attracted to the light during this time. At 11 p.m. the temperature was 22°C and again no males were found.

Table 1 shows the time of day during which males emerged from their pupal skins and the time they first took flight under field conditions. Ninety-one percent emerged during the afternoon with 44% emerging before 3:00 p.m. and 47% emerging between 3 and 6:00 p.m. Most males took flight on the same afternoon as they emerged, with 34% flying before 3:00 p.m. and 53% flying between 3 and 6:00 p.m. for a total of 87%.

Table 2 shows the times of day at which males emerged from two populations of bagworm pupae. One had been reared in the laboratory as described above and was kept at 25°C and a 16 hour photophase during the pupal stage. The other had been collected in the field as pupae and was kept at 29°C and a 12.5 hour photophase. There is obviously no daily rhythm of emergence in either population. Analysis of variance shows that at the 5% level of significance the two populations do not differ in the distribution of emergences during the day.

Under field conditions almost all emergences occurred between 9:00 a.m. and 6:00 p.m., suggesting that the time of emergence is governed by photoperiodic cues (Table 1). However, the data in Table 2 show that this is certainly not the case. Here two populations of bagworms which were kept at constantly warm temperatures emerged in approximately equal numbers in all time periods during both the photophase and scotophase portions of a twenty-four hour cycle. It seems a safe assumption that under field conditions emergences occurred between 9:00 a.m. and 6:00 p.m. because the temper-

TABLE 1. Number of adult male *Thyridopteryx ephemeraeformis* emerging from pupae kept under field conditions and the time of day at which the males took flight—1969. [a]

| Time Period | Number Emerging | *Number taking flight for first time* | |
|---|---|---|---|
| | | Flew on Day of Emergence | Flew on Day after Emergence |
| 6 a.m.-9 a.m. | 0 | 0 | 1 |
| 9 a.m.-noon | 13 | 0 | 12 |
| noon-3 p.m. | 82 | 61 | 0 |
| 3 p.m.-6 p.m. | 87 | 95 | 2 |
| 6 p.m.-9 p.m. | 3 | 11 | 0 |
| 9 p.m.-midnight | 0 | 0 | 0 |
| midnight-3 a.m. | 0 | 0 | 0 |
| 3 a.m.-6 a.m. | 0 | 0 | 0 |
| Total | 185[a] | 167[a] | 15[a] |

[a]Difference between number emerged and taking flight results from structural damage which occurred during the emergence process.

TABLE 2. Number of adult male *Thyridopteryx ephemeraeformis* emerging from pupae kept under controlled conditions—1969.

| Time Period | *Conditions* | |
|---|---|---|
| | 16 Hour Photophase 25°[a] | 12 1/2 Hour Photphase 30°[a] |
| 6 a.m.-9 a.m. | 5 | 11 |
| 9 a.m.-noon | 4 | 13 |
| noon-3 p.m. | 6 | 11 |
| 3 p.m.-6 p.m. | 5 | 14 |
| 6 p.m.-9 p.m. | 6 | 12 |
| 9 p.m.-midnight | 5 | 12 |
| midnight-3 a.m. | 4 | 11 |
| 3 a.m.-6 a.m. | 5 | 11 |
| Total | 40 | 95 |

[a]Distribution not significantly different at the 5% level.

ature then tended to be above some minimum required for emergence. This has not, of course, been conclusively shown.

By observing those males which did not fly the day they emerged, we noted that males still on the bag when the temperature dropped below 18°C did not fly until the following day, when the temperature reached at least 18°C. Subsequent observations continued to show that flight would occur only at 18°C or above.

Our results support the observation that males may emerge and fly during the warm morning hours (Riley, 1869) and that males fly most frequently after mid-day and before dark (Jones and Parks, 1928). They also support the general observations that males emerge and fly during the months of September and October.

## Literature Cited

Jones, F. M. 1927. The mating of the Psychidae (Lepidoptera). Trans. Amer. Entomol. Soc. 53:293-314.

Jones, F. M. and H. B. Parks. 1928. The bagworms of Texas. Texas Agr. Exp. Sta. div. of Entomol. Bull. 382:3-36.

Kaufmann, T. 1968. Observations on the biology and behavior of the evergreen bagworm moth, *Thyridopteryx ephemeraeformis* (Lepidoptera: Psychidae). Ann. Entomol. Soc. Amer. 61:38-44.

Riley, C. V. 1869. The bag-worm, alias basket-worm, alias drop-worm. (*Thyridopteryx ephemeraeformis* Haw.). Amer. Entomol. 2:35-38.

Wollerman, E. H. 1965. Bagworm. U.S.D.A. Forest Pest Leafl. 97:1-7.

**2.0112 Seasonal and daily emergence patterns of adult Thyridopteryx ephemeraeformis (Lepidoptera: Psychidae).**

Abstract.—The male of the evergreen bagworm, *Thyridopteryx ephemeraeformis* emerges and flies during the day when the temperature is high enough for these activities. It appears that photoperiod has no effect on emergence and flight time. Adults emerge during the last half of September and early part of October at the latitude of central Illinois.—R. D. Morden and G. P. Waldbauer, *Department of Entomology, University of Illinois, Urbana, IL 61801.*

*Descriptors*: Lepidoptera; Psychidae; *Thyridopteryx ephemeraeformis*, emergence patterns; bagworm; emergence patterns.